

The Causes of Maternal Mortality in West Azarbaijan-Iran Province During 2013-2020

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ABSTRACT

Background & Objective: Maternal mortality is one of the most important health issues worldwide. Therefore, the current study aimed to determine the causes of maternal mortality in West Azarbaijan-Iran province during 2013-2020.

Materials & Methods: In this retrospective cross-sectional study, demographic data and information on maternal deaths (based on the Pregnancy Mortality Surveillance System) were obtained from the treatment deputy of Urmia University of Medical Sciences. The data were collected and analyzed in the West Azarbaijan-Iran province during the 2013-2020 years.

Results: Over seven years, 102 maternal deaths occurred. The frequency of direct, indirect, and unknown causes of maternal mortality was 35.28%, 60.8%, and 3.92% respectively. Among direct causes, the leading cause of maternal mortality was hemorrhage (23.52%) and sepsis was the next order (7.84%). In indirect causes, brain diseases had the highest frequency (18.9%). Gestational age, place, and technique of delivery were highly related to the death causes ($p < 0.05$). The mother's age (OR: 1.14, 95% CI: 0.51-2.52), being rural (OR: 1.34, 95% CI: 0.57-3.15), and having a history of diseases (OR: 1.31, 95% CI: 0.59-2.89) were positively associated with the risk of infant's mortality. While the gestational age ($> 37w$) (OR: 0.047, 95% CI: 0.013-0.18, $P < 0.001$) and high education level (OR: 0.64, 95% CI: 0.27-1.57, $P = 0.33$) were inversely correlated with an increased risk of infant mortality.

Conclusion: Direct and indirect causes of hemorrhage were the most common cause of maternal death. Gestational age, delivery place, and technique of delivery were significantly associated with the type of death causes.

Keywords: Iran, Maternal Death, Maternal Mortality, Pregnancy, Risk Factors



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Introduction

Maternal mortality is one of the most important health issues worldwide, and it is used as an indicator of the quality of surveillance system and well-being (1-3). According to the International statistical classification of diseases (ICD), Maternal mortality is defined as any death that occurs during pregnancy or within 42 days after the termination of pregnancy that is not caused by an accident or incidental causes (4, 5). Based on the World Health Organization (WHO) estimation of data from 185 countries, globally 295000 (279000 to 340000) maternal deaths occurred in 2017 with an overall maternal mortality rate (MMR) of 211 (199 to 243) per 100000 live births (5). MMR is high in the least developed countries in 2017 at 415 maternal deaths per 100 000 live births, which is more than 40 times higher than in Europe. Central Asia, Eastern Asia, and Western Asia have a low MMR (< 100 maternal deaths per 100 000 live births) (5). Most maternal deaths occur in undeveloped regions such as sub-Saharan Africa (6).

The Islamic Republic of Iran has been identified by the WHO as one of the countries achieving Millennium Development Goals (MDGs) with a 75% reduction in MMR by the year 2015, so MMR in Iran was reported 274, 150, 94, 38, 30, 25 and 16 per 100,000 live births in 1975, 1990, 1995, 2005, 2008, 2015 and 2017 respectively (2, 7).

According to the ICD classification, maternal deaths are classified as direct and indirect (8). Direct maternal fatalities include those brought on by obstetric complications throughout pregnancy (pregnancy, labor, and puerperium), as well as by interventions, omissions, improper care, or a series of incidents brought on by any of the aforementioned. The term "indirect obstetric deaths" (also known as "indirect maternal deaths") refers to maternal deaths brought on by a pre-existing condition or a condition that arose during pregnancy but was made worse by the physiological consequences of pregnancy (5, 9). The most important direct causes of maternal deaths are

bleeding, hypertension, sepsis, abortion, and other unknown causes (10-12).

The studies have reported different causes of maternal deaths. In a study in the United States, cardiovascular disease was the first cause of death, while infection and bleeding were in the next order (13). In another study, sepsis, heart disease, bleeding, thromboembolism, and hypertension were the highest causes of death, respectively (14). In a study in Tehran, heart disease was the first cause of death with 20.1%, and respiratory diseases and complications of labor (bleeding and infection) were in the next rank (15).

It's critical to pinpoint the causes of maternal death in order to enhance the standard of healthcare services and reduce maternal mortality. Therefore, the goal of the current study was to identify the factors that led to maternal deaths in the West Azarbaijan-Iran province between 2013 and 2020.

Methods

In this retrospective cross-sectional study, the data on maternal deaths were collected and analyzed in the West Azarbaijan-Iran province during the 2013-2020 years. During this period, 102 maternal deaths were reported. Maternal mortality is defined by the WHO's International statistical classification of diseases and related health problems (ICD) as any death that occurs during pregnancy or within 42 days of the termination of pregnancy but is not due to an accident or incident (4, 5). A checklist was used to extract all relevant information from the study. Demographic characteristic variables including age, gestational age, educational level, residency, disease history, delivery place, technique of delivery, and anesthesia type in cesarean section, pregnancy outcome (live births or fetal death) were collected through medical records. Information on maternal deaths (based on Pregnancy Mortality Surveillance System) was obtained from the treatment deputy of Urmia University of Medical Sciences. The causes of maternal deaths are categorized into direct, indirect, and unknown groups. Direct maternal death causes were hemorrhage, sepsis, HELLP syndrome and preeclampsia, placenta, Atonic uterus, and septic shock. Indirect causes were brain disease, cardiovascular disease, pulmonary causes, hematologic disease, hepatitis, self-burning, and suicide. This study was approved by the ethics committee of Urmia University of Medical Sciences with ID number: IR.UMSU.REC.1399.171. All data were collected and analyzed.

Statistical analysis

Data were presented as mean $\pm$ standard deviation (SD) for continuous variables and frequency (percent) for categorical variables. The Chi-square Test or Fisher's Exact Test was used for the comparison of maternal mortality caused by demographic variables. The Odds Ratio (OR) of fetal death for demographic variables was calculated using logistic regression. Data

analysis was performed using SPSS17 software (IBM, USA), and a p-value less than 0.05 was considered statistically significant.

Results

In West Azarbaijan province, a total of 102 maternal deaths occurred between 2013 until 2020. The mean maternal age was 30.1 ± 6.8 years and the mean gestational age at the time of death was 29.2 ± 10.5 weeks respectively. Women had an illiteracy rate of 18.8%, as well as elementary, high school, and academic education levels of 48.9%, 20.8%, and 11.5%, respectively. The urban residency was 64.3%. There was a history of disease in 52% of subjects. Delivery or termination of pregnancy in 92.8% of subjects was done in university hospitals. Spinal anesthesia was done in 77.5% of cesarean sections. Maternal mortality causes were 35.28%, 60.8%, and 3.92% of direct, indirect, and unknown causes respectively (Table 1).

Table 2 shows the direct and indirect causes of maternal mortality. Among direct causes, the hemorrhage had the highest frequency (23.52%). Other direct causes of maternal mortality were sepsis (7.84%), HELLP syndrome (2.94%), and preeclampsia (0.98%). Among indirect causes, brain diseases including brain tumors, epilepsy, and glioblastoma had the highest frequency (18.9%). Pulmonary causes (17.65%), self-burning (9.8%), and cardiovascular diseases (8.82%) had the next orders of indirect mortality causes. Unknown mortality causes were 3.92%.

In Table 3 the maternal mortality causes were compared according to demographic variables. Gestational age, delivery place, and technique of delivery were significantly associated with death causes. Among women with a gestational age ≤ 37 weeks the frequency of direct and indirect causes was more frequent at 24.6% and 70.8% respectively, while in women with a gestational age of >37 weeks, the rate of direct and indirect causes was 51.9% and 48.1% and this difference was statistically significant between two groups ($p=0.03$). In women with normal vaginal delivery, the frequency of direct and indirect causes of death was 47.6% and 52.4% respectively. Among cesarean sections, 45% of mortality causes were direct and 52.5% of them were indirect causes. In women with abortion or curettage, the indirect causes had the highest frequency (73.2%) ($p=0.04$).

The odds ratio (OR) of newborns mortality according to demographic variables was shown in Table 4. The mother's age (OR= 1.14, 95% CI: 0.51-2.52), being rural (OR=1.34, 95% CI: 0.57-3.15), and having a history of diseases (OR=1.31, 95% CI: 0.59-2.89) were positively correlated with an increased risk of infant mortality. While, the gestational age $>37w$ (OR=0.047, 95% CI: 0.013-0.18, $p<0.001$) and high education level of maternal (OR= 0.64, 95% CI: 0.27-1.57, $P=0.33$)

were inversely correlated with an increased risk of infant mortality.

Table 1. Characteristics of participants

Variables	Mean±SD
Age (years)	30.1±6.8
Gestational age (weeks)	29.2±10.5
Education level	N (%)
Illiterate	18 18.8)
Elementary	47 48.9)
High school	19 20.8)
Academic	11 (11.5)
Residence	N (%)
Urban	63 (64.3)
Rural	35 (35.7)
Disease history	N (%)
No	48 48)
yes	53 (52)
Delivery place/ termination of pregnancy	N (%)
University hospitals	90 92.8)
Private hospitals	3 (3.1)
In road	4 (4.1)
Technique of delivery	N (%)
Normal vaginal delivery	21 (20.6)
Cesarean section	40 39.2)
Abortion/Curettage	41 (40.2)
Anesthesia type in Cesarean section	N (%)
Spinal	31 77.5)
Public	9 (22.5)
Pregnancy outcome	N (%)
Live births	43 43)
dead	57 (57)
Maternal mortality causes	N (%)
Direct	36 35.28)
Indirect	62 (60.8)
Unknown	4 (3.92)

Table 2. Maternal mortality causes in West-Azarbaijan province during 2013-2020

Mortality causes	Frequency	Percent (%)
1. Direct		
hemorrhage	24	23.52
sepsis	8	7.84
HELLP syndrome	3	2.94

Mortality causes	Frequency	Percent (%)
Eclampsia-preeclampsia	1	0.98
Total direct	36	35.28
2. Indirect		
Brain disease	19	18.63
Cardiovascular disease	9	8.82
Pulmonary causes	18	17.65
hematologic disease	3	2.9
hepatitis	2	1.95
self-burning	10	9.80
Suicide	1	0.98
Total indirect	62	60.8
3. Unknown	4	3.92
Total	102	100

Table 3. Comparison of maternal mortality causes by demographic variables

		Mortality causes, n (%)				
		Direct	Indirect	unknown	total	p-value
Mother's Age	≤30	15 (31.9)	30 (63.8)	2 (4.3)	47 (100)	0.82
	>30	21 (38.2)	32 (58.2)	2 (3.6)	55 (100)	
Gestational age	≤37	16 (24.6)	46 (70.8)	3 (4.6)	65 (100)	0.03
	>37	14 (51.9)	13 (48.1)	0	27 (100)	
Residence	Urban	21 (33.3)	40 (63.5)	2 (3.2)	63 (100)	0.81
	Rural	12 (34.3)	21 (60)	2 (5.7)	35 (100)	
Education	Primary level	24 (36.9)	38 (58.5)	3 (4.6)	65 (100)	0.58
	High level	8 (25.8)	22 (71)	1 (3.2)	31 (100)	
Disease history	No	16 (32.7)	30 (61.2)	3 (6.1)	49 (100)	0.57
	yes	20 (37.7)	32 (60.4)	1 (1.9)	53 (100)	
Delivery place	University Hospitals	32 (35.6)	56 (62.2)	2 (2.2)	90 (100)	0.04
	Non-University Hospital	2 (28.6)	3 (42.9)	2 (28.6)	7 (100)	
Technique of delivery	Normal vaginal delivery	10 (47.6)	11 (52.4)	0	21 (100)	0.04
	Cesarean section	18 (45)	21 (52.5)	1 (2.5)	40 (100)	
	Abortion/Curettage	8 (19.5)	30 (73.2)	3 (7.3)	41 (100)	
Anesthesia type in Cesarean section	Spinal	12 (38.7)	18 (58.1)	1 (3.2)	31 (100)	0.25
	Public	6 (66.7)	3 (33.3)	0	9 (100)	
Pregnancy outcome	Live births	18 (41.9)	25 (58.1)	0	43 (100)	0.11
	Fetal death	16 (28.1)	37 (64.9)	4 (7)	57 (100)	

Table 4. The relationship between demographic variables and fetal mortality

variables	OR	95%CI for OR	P-value
Mother's age	≤30	1(reference)	-
	>30	1.14	0.51-2.52
Gestational age	≤37	1	-
	>37	0.047	0.013-0.18
Residency	Urban	1	-
	Rural	1.34	0.57-3.15
Education level	Primary level	1	-
	High level	0.64	0.27-1.57
Disease history	No	1	-
	yes	1.31	0.59-2.89

Discussion

Despite many advances in the healthcare system, the high and unacceptable level of maternal mortality is one of the common issues of global health. The death of a mother damages the family and society (10). There are two types of maternal deaths: direct and indirect. While indirect maternal fatalities are those brought on by a systemic disease or a disease that is made worse by pregnancy, direct maternal deaths are diseases that are particularly caused by pregnancy or its consequences. (8). Therefore, the goal of the current study was to identify the factors that led to maternal deaths in the West Azarbaijan-Iran province between 2013 and 2020.

The current study revealed that indirect factors accounted for the majority of maternal fatalities (60.8%), and 35.28% and 3.92% of causes were direct and unknown respectively. In a study by Mohammed et al. (16) in Sudan, direct obstetric causes were reported for 58.4% of deaths. In another study by Sitaula et al. (17) in Nepal, the direct causes including obstetric hemorrhage, hypertensive disorder of pregnancy, and sepsis were 69% of the leading causes of maternal death. In a study in India, 55.8% of maternal death causes were direct causes (18). In a study in Southeast Iran, the direct causes (hemorrhage, eclampsia, and preeclampsia) were 64.7% of death maternal causes (10). Kodan et al. (19) showed that the direct (63%), indirect (32%), or unspecified (5%) causes were maternal mortality causes. Most studies have reported direct causes as the most common causes of maternal death, while in the current study, the most common causes of maternal deaths were indirect causes. The differences in the causes of maternal mortality can be closely related to postpartum care (18). On the other hand, having a history of diseases can affect death causes and increase the risk of death due to related diseases in women who have a history of diseases among direct and indirect causes by 37.7% and 60.4% respectively.

Our findings showed that among direct causes, hemorrhage was the most common cause of maternal death (23.52%). Other direct causes of maternal mortality were sepsis (7.84%), HELLP syndrome (2.94%), and preeclampsia (0.98%). Consistent with our results in several studies, hemorrhage was reported as the most direct common cause of maternal death (6, 10, 16-18, 20-23).

The current study showed that among indirect causes brain diseases including brain tumors, epilepsy, and glioblastoma were the most common cause of maternal death (18.9%), and pulmonary causes, self-burning, and cardiovascular diseases had the next ranks of indirect mortality causes. In a study in the United States, cardiovascular disease was the first cause of death, while infection and bleeding were in the next order (13). In another study, sepsis, heart disease, bleeding, thromboembolism, and hypertension were the highest causes of death, respectively (14). In a study in Tehran-Iran, heart disease was the first cause of death with 20.1%, and respiratory diseases and complications of labor (bleeding and infection) were in the next ranks (15). Maro, et al. (20) in Tanzania reported that HIV/AIDS and Heart diseases were the leading causes of indirect maternal deaths, contributing 31% and 22% respectively. In the study's Kachhwaha, et al. (24) indirect causes accounted for 42.4% of deaths which included hepatitis (21.7%), and heart diseases (9.8%).

The results of this study demonstrated a substantial relationship between gestational age, delivery place, and delivery technique and mortality reasons. So, in women with a gestational age ≤ 37 weeks the indirect causes were more common (70.8%), while in women with a gestational age of >37 weeks, the rate of direct causes was higher (51.9%). The reason for the higher indirect causes of death in women whose gestational age was less than 37 can be linked to having a history of diseases. Therefore, in the current study 76% of

women with gestational age ≤ 37 weeks had a history of a disease, while this rate was 24% in women with gestational age > 37 . In women who had abortions or curettage, the indirect causes of death were significantly higher than in women with natural delivery or cesarean section. In university hospitals, the frequency of indirect causes of death was significantly higher than direct causes. Consistent with our findings, Zalvand, et al. (2) reported that type of delivery, socioeconomic status of mothers, and locations of birth were the most important related factors of maternal mortalities. A study was shown the causes of death among different socio-demographic subgroups were different, and healthcare delivery is one of the main factors in reducing maternal deaths (25). According to a study, women who delivered birth in for-profit hospitals as opposed to teaching hospitals had an increased risk of postpartum maternal death due to complications during or after delivery (26).

A current study showed that the increases in the mother's age, being rural, and having a history of diseases were positively correlated with an increased risk of infant mortality, while, the gestational age (>37), and the high education level of maternal were inversely associated with the risk of infant mortality. In accordance with our findings, Vijay, et al. (27) found that mothers who did not deliver birth in a hospital and omitted any prenatal visits had considerably higher infant death rates. Another study showed that small birth size correlated with an increased risk of infant mortality (28). The strength of this study is that the data on maternal death during seven years recorded in the deputy of treatment was reviewed, which is important in terms of the validity of the information, although the maternal mortality rate (MMR) was not recorded. In summary, it's critical to determine the causes of

maternal mortality in order to enhance the standard of medical care and reduce maternal mortality.

Conclusion

In conclusion, the most common causes of maternal deaths were indirect causes (60.8%), and the frequency of direct and unknown causes of maternal mortality was 35.28% and 3.92% respectively. Among direct causes, hemorrhage was the most common cause of maternal death and sepsis was in the next rank. Among indirect causes, brain diseases including brain tumors, epilepsy, and glioblastoma were the most common cause of maternal death. The current study showed that gestational age, delivery place, and technique of delivery were significantly correlated with death causes. So, in women with a gestational age of ≤ 37 weeks the indirect causes and in women with a gestational age of >37 weeks the rate of direct causes were more common. In women who had abortions or curettage, the indirect causes of death were significantly higher than in women with natural delivery or cesarean section. In university hospitals, the rate of indirect causes of death was significantly higher than direct causes.

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Conflict of Interest

The authors declare that they have no competing interests.

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